

# *Electrospark Deposition for U.S. Navy Component Repair Applications*

**January 2006 HCAT Meeting  
San Diego, CA**

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# *Targeted Applications*

- Steering & Diving Control Rods
- Hull Valve Stems
- Alloy 625 Seawater Components

# *Control Rods and Seawater Hull Valve Stems*

- **ISSUE**

Unacceptable corrosion/wear of Alloy K500 control rods and valve stems

- **SOLUTION**

Electrospark deposition of Alloy 400 to re-establish original dimensions

# *Hull Valve Stem*



# *Steering and Diving Control Rod*





# *Steering and Diving Control Rod*

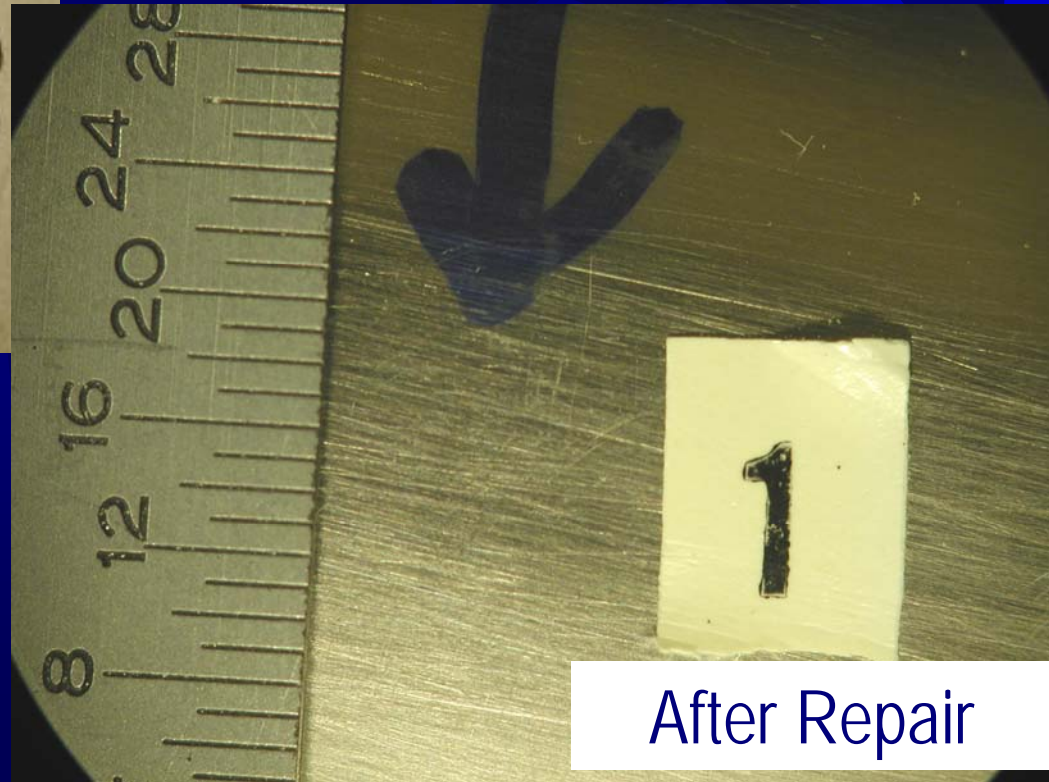


# *ESD Control Rod Repair*

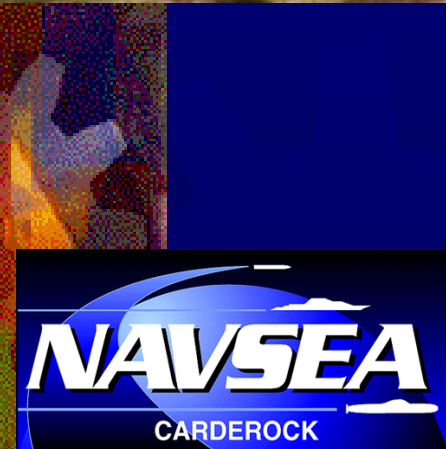
Before Repair



Defect Measured  
0.016" to 0.021" in Depth



After Repair





# *ESD Control Rod Repair*

Before Repair



Defect Measured  
0.012" to 0.017" in Depth



After Repair

# *ESD Control Rod Repair*

Before Repair

Defect Measured  
0.006" Maximum Depth

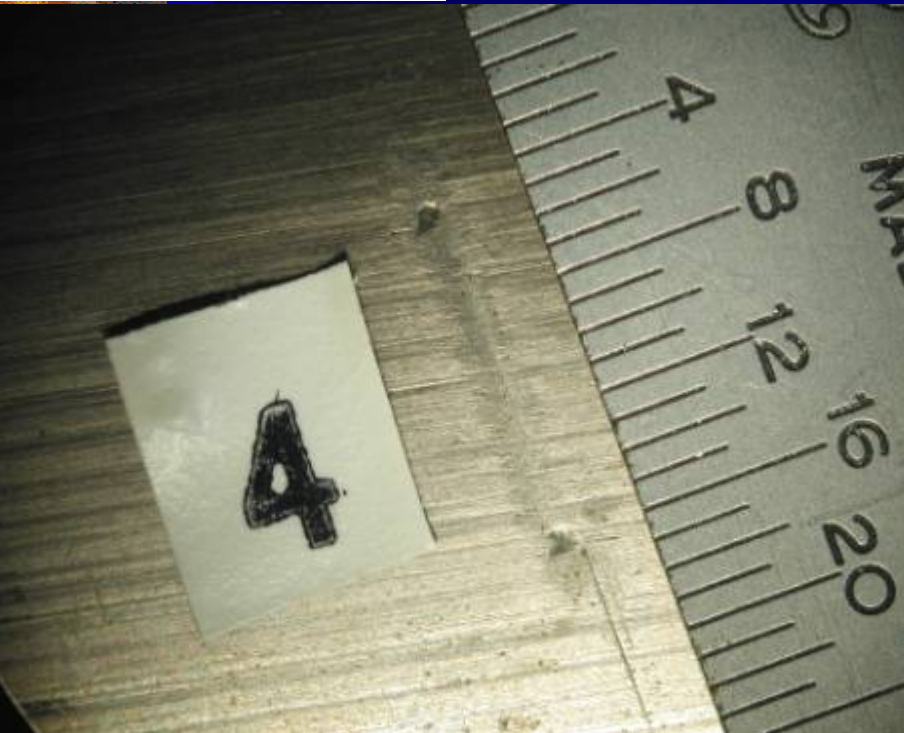


After Repair



# *ESD Control Rod Repair*

Before Repair



Defect Measured  
0.003" to 0.013" in Depth

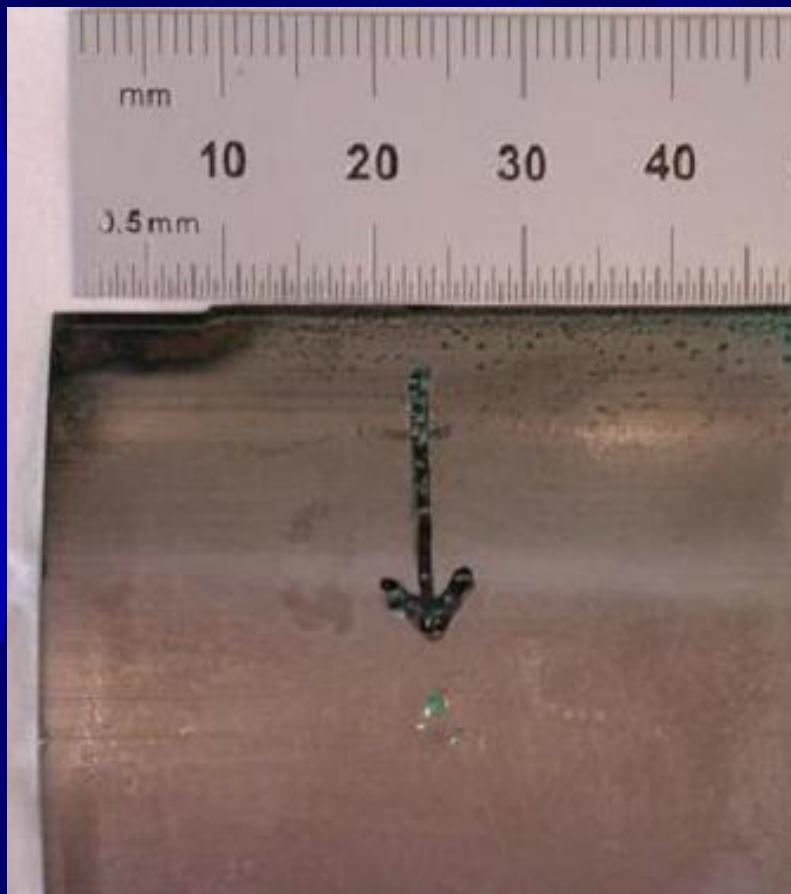


After Repair

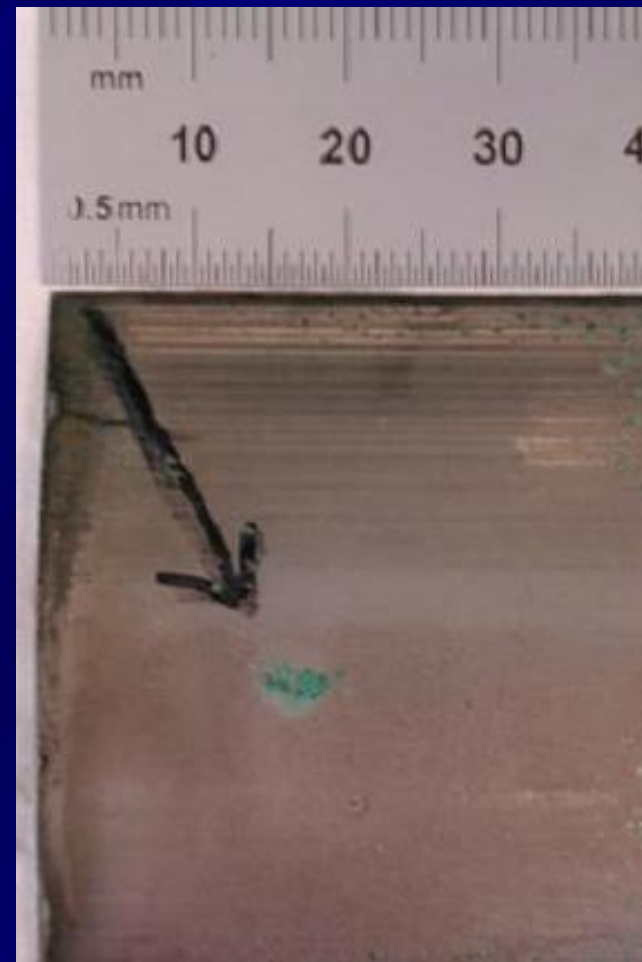
# ***ESD Repair Section #4***



# ***ESD Repair Sections After 127 Days in Seawater***



Section #1

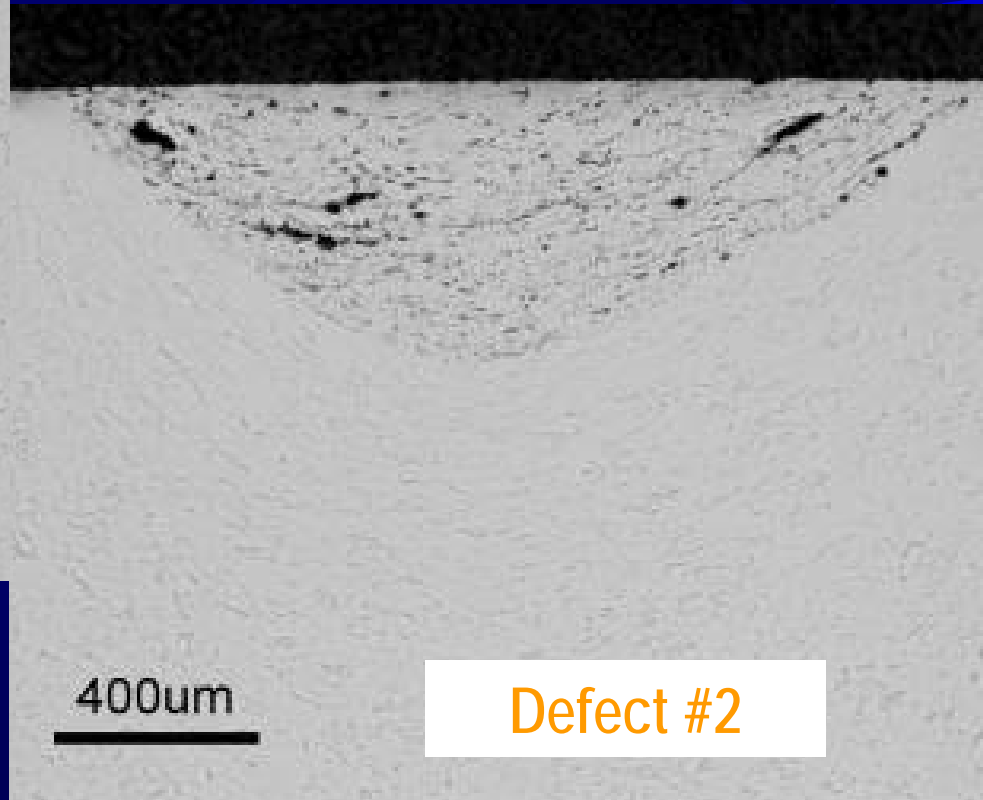
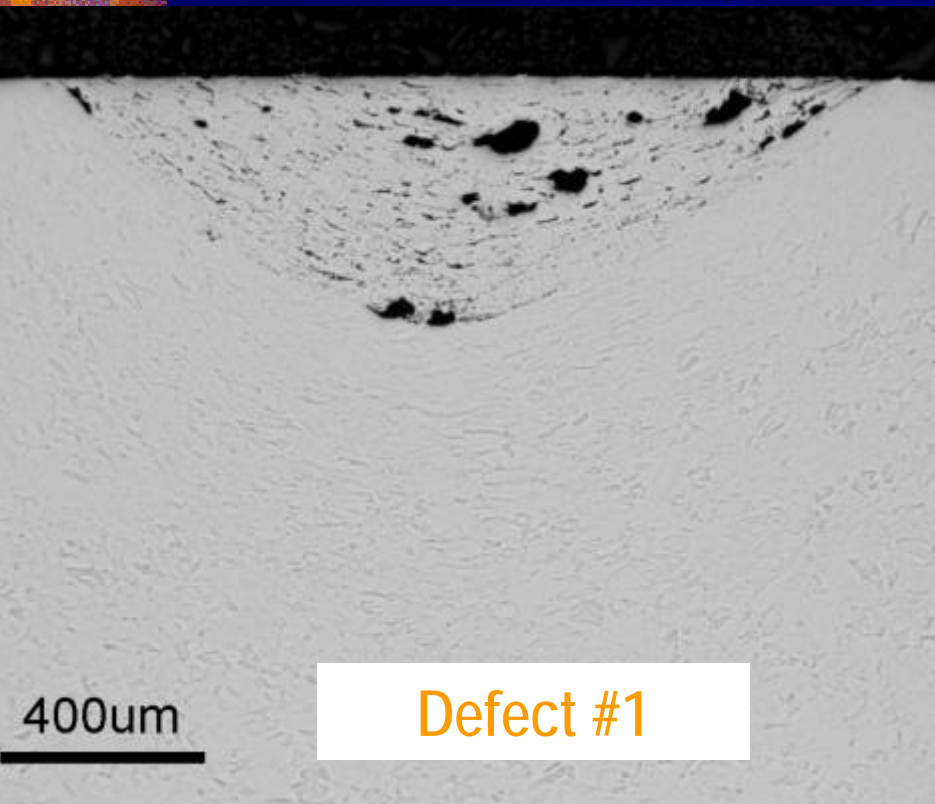


Section #3

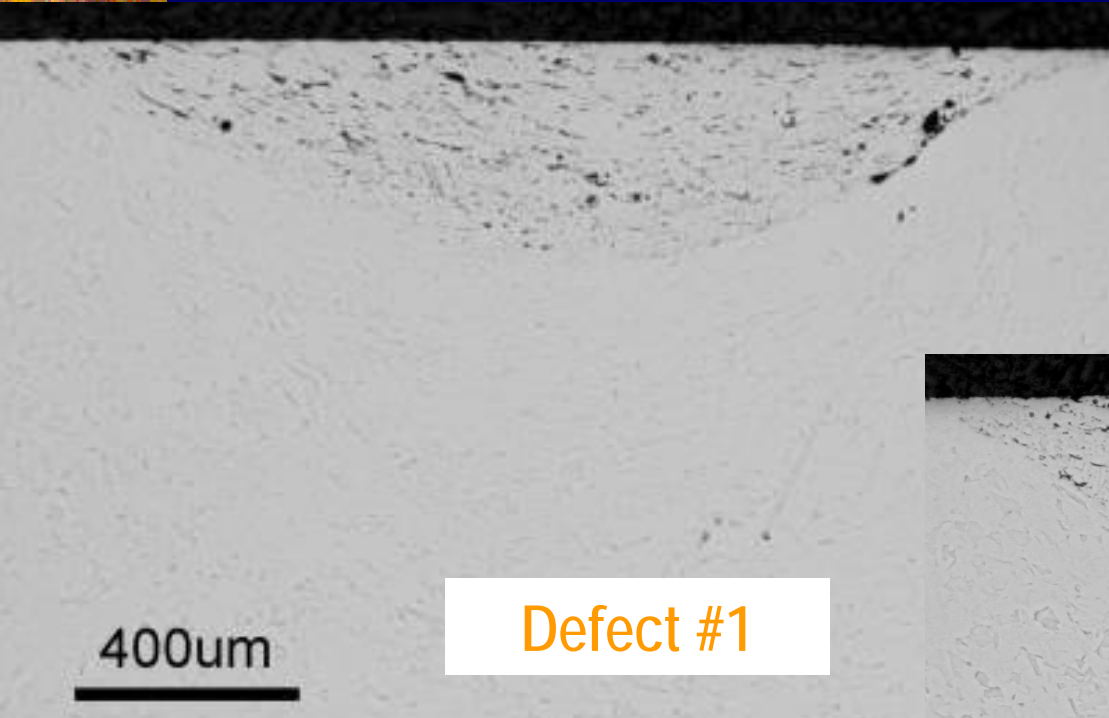


# *Blunt Chisel Defects*

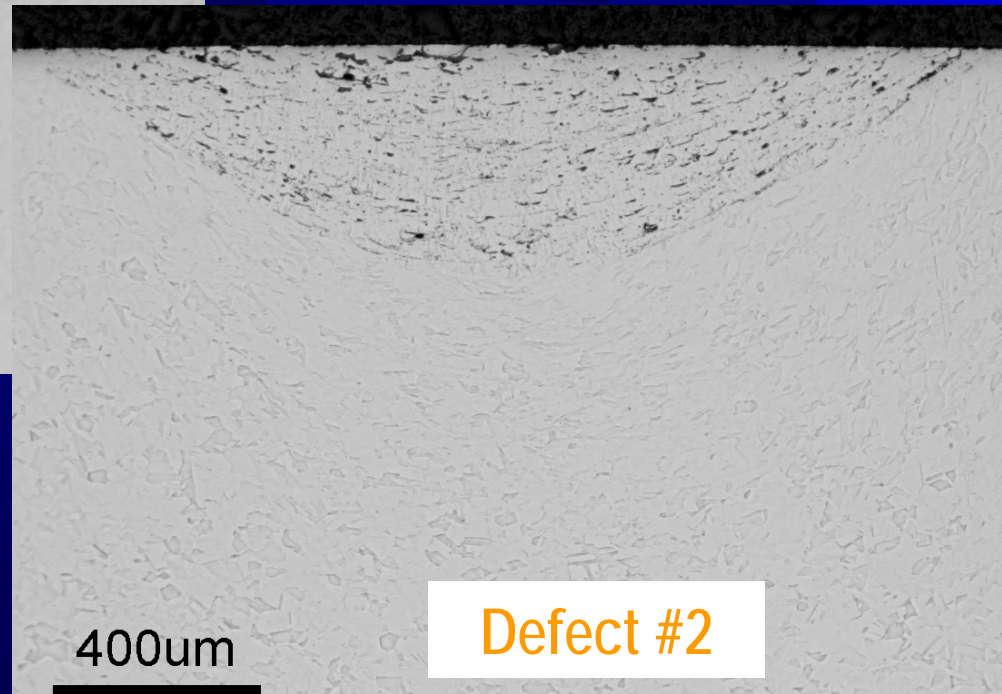
## *ESD Repaired with Alloy 400*



# *Blunt Chisel Defects Rounded Out with Dremel Tool ESD Repaired with Alloy 400*



Defect #1



Defect #2



# *ESD Control Rod*

## *Demonstration Repair Status*

- Identified voids and microcracks within narrow groove repair area and corrosion after seawater immersion
- Simulated defect study identified improvements in ESD repair with less severe defect geometry
- Additional research need to identify NDE methods to assure optimum repair quality

# *Crevice Corrosion Repair of Alloy 625 Components*

- ★ Develop NSWCCD Capability to Deposit Crevice Corrosion Resistant Ni-Cr-Mo Alloys on 625 Substrates
  - Alloy C276
  - Alloy 59
  - Alloy 686

# *ESD of Ni-Cr-Mo Alloys on Alloy 625*

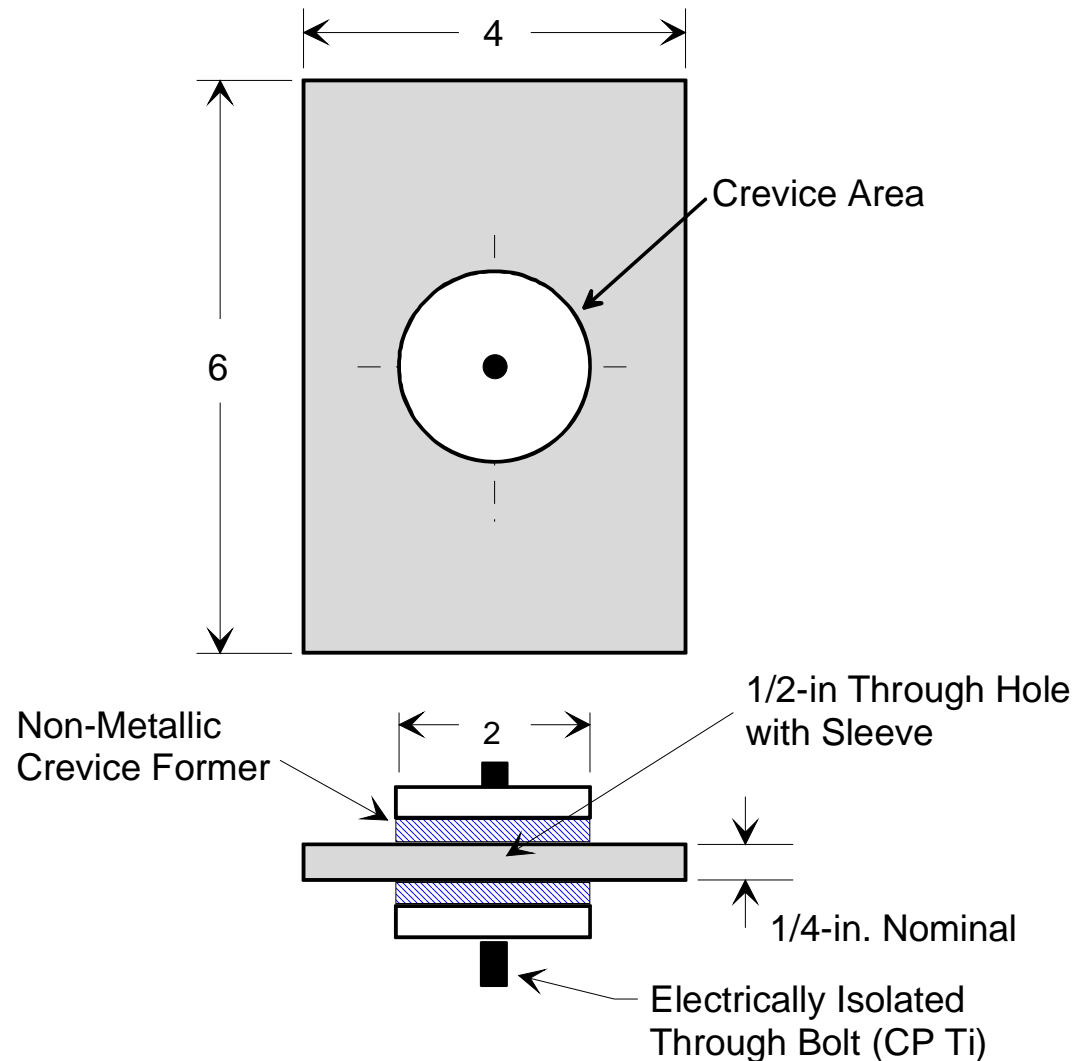
## **Crevice Corrosion Testing**

- ESD Coatings of Alloy 686, C276, and 59 Applied on Alloy 625 Panels
- Control Specimens Include Uncoated Alloy 686, C276, 59, and 625
- Triplicate Specimens Exposed per Condition for **180** and **365** Days in Filtered, Natural Seawater Immersion

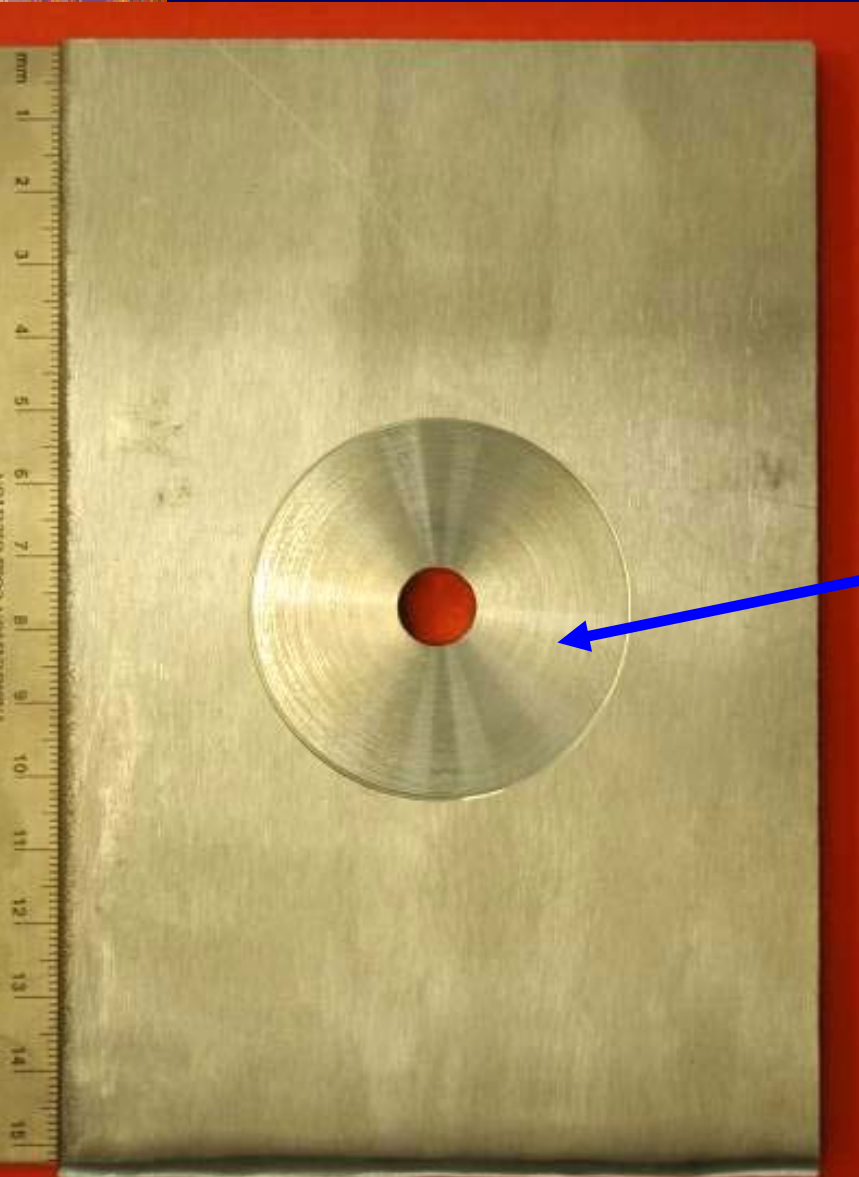


# *ESD of Ni-Cr-Mo Alloys on Alloy 625*

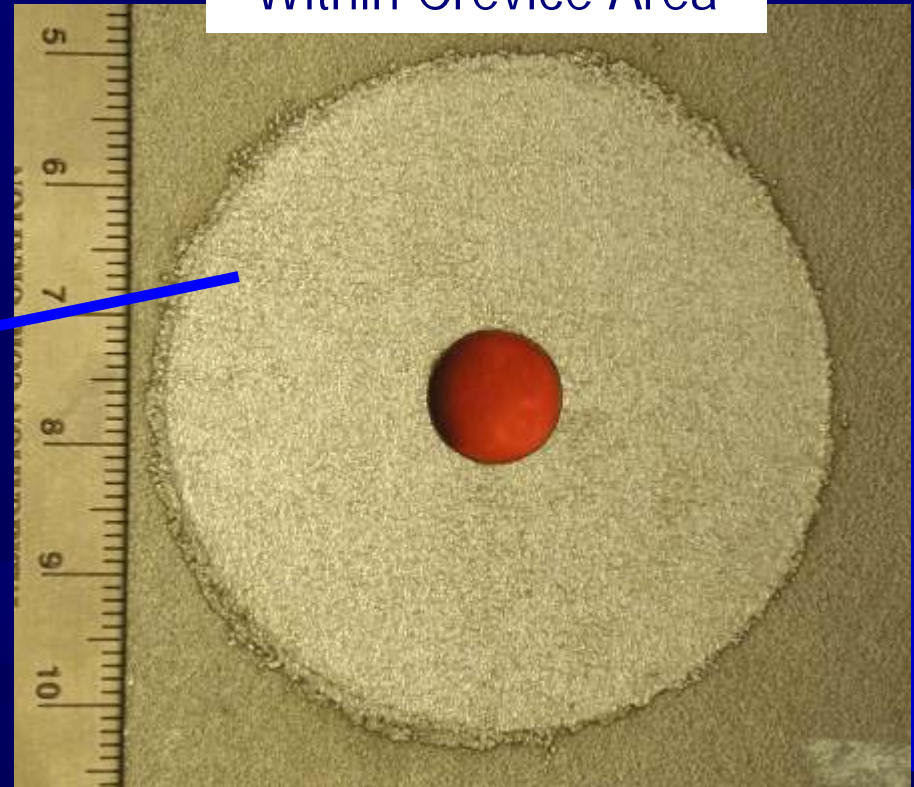
## Crevice Corrosion Testing in Natural Seawater



# *ESD of Ni-Cr-Mo Alloys on Alloy 625*



ESD Coating Applied  
Within Crevice Area



# *Crevise Corrosion Testing of ESD Ni-Cr-Mo Alloys on 625*



# *Crevice Corrosion Test Results After 365 Days in Seawater*

- ESD Alloy C276 Coated Specimens Showed Crevice Susceptibility at Crevice Sites
  - Corrosion initiated between 9 and 14 days' immersion
  - Maximum depth of attack = 0.005 in. (0.13 mm)
- ESD Alloys 686 and 59 on 625 & Wrought Control Specimens of Alloys 625, 59, 686, and C276 Remained Corrosion Resistant After 365 Days

# *ESD Alloy C276 Coated Specimens After 180 Days in Natural Seawater*



Maximum Depth of Attack = 0.005 in. (0.13 mm)  
Initiated After 9-14 Days' Immersion